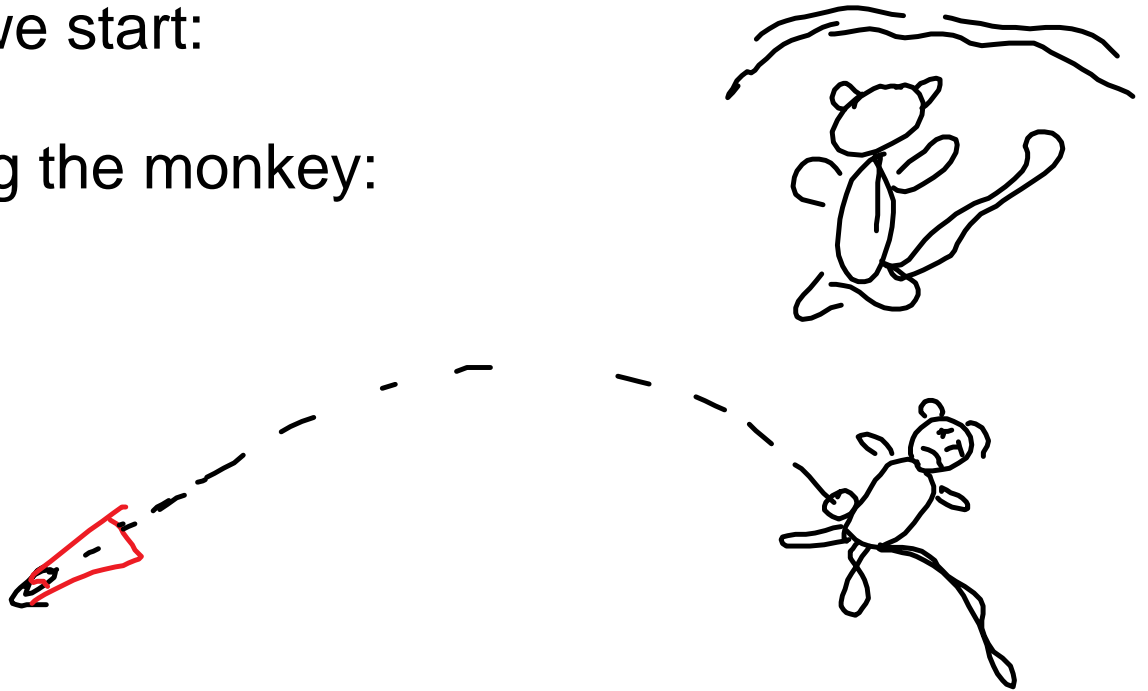


2-D Dynamics - Free body Diagrams - Slopes
Write out Newton's 3 Laws from memory
Define Net Force, Restoring Force (Normal Force)

before we start:

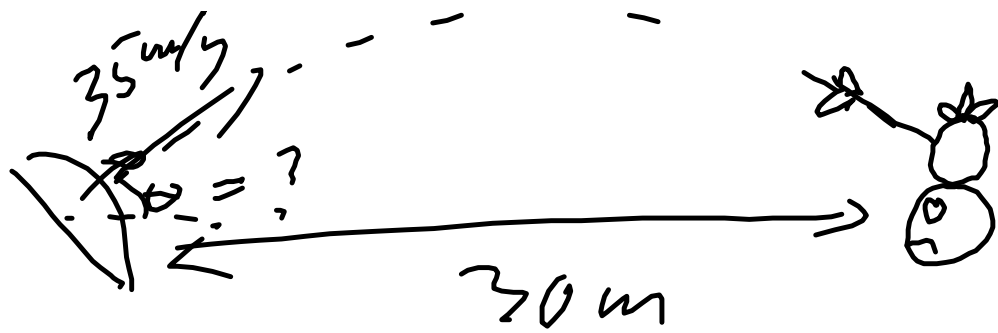
Shooting the monkey:



<http://techtv.mit.edu/videos/735-monkey-and-a-gun>

The monkey falls just as the bullet is shot. If you aim at the monkey, the bullet will hit the monkey because gravity pulls on the bullet the same amount of acceleration as the monkey.

Q45:



$$\text{Range} = \frac{V^2 \sin 2\theta}{g}$$

$$S_x = V_x t = V \cos \theta t$$

$$S_y = u_y t + \frac{1}{2} g t^2 = 0$$

$$t = \frac{-2u_y}{g} = \frac{-2V \sin \theta}{g}$$

$$S_x = V \cos \theta \left(\frac{-2V \sin \theta}{g} \right)$$

$$S_x = \frac{-2V^2 \cos \theta \sin \theta}{g}$$

$$\begin{aligned} \sin 2\theta &= 2 \cos \theta \sin \theta \\ &= \sin 2\theta \end{aligned}$$

$$S_x = \frac{-V^2 \sin 2\theta}{g}$$

$$30 = \frac{-(35)^2 \sin 2\theta}{-9.81}$$

$$2\theta = \sin^{-1}$$

$$2\theta = \text{Asin}(30 \times 9.81 / (35 \times 35)) = 13.90099488374725$$

$$\theta = 13.90099488374725 / 2 = 6.95049744187363$$

$$= 7.0^\circ$$

or 83° also works but bad idea

Newton's 3 Laws of Motion

First Law - Inertia

Objects move at constant velocity (speed and direction) unless an unbalanced force is applied.

Second Law - $F_{\text{net}} = ma$ or $= \Delta p / \Delta t$ (original and more universal - rockets and relativity)

What is net force? Vector sum of all force.
Resultant of the vector addition diagram.

Third Law - Action-reaction Law

For every force object A acts on object B, object B reacts with an equal and opposite force on A.

Restoring Force (Normal Force) is the force a surface responds with when you push on it.

Careful, surface force is the total force off the surface. It is usually analyzed in terms of components - perpendicular component is called the Restoring (symbol R or F_R or F_N) or Normal Force. The parallel component of the surface force is the force of friction, F_f .

Avery: "If every force has an equal and opposite force, why can things accelerate?"

Derek: "Because the equal and opposite forces act on different objects."

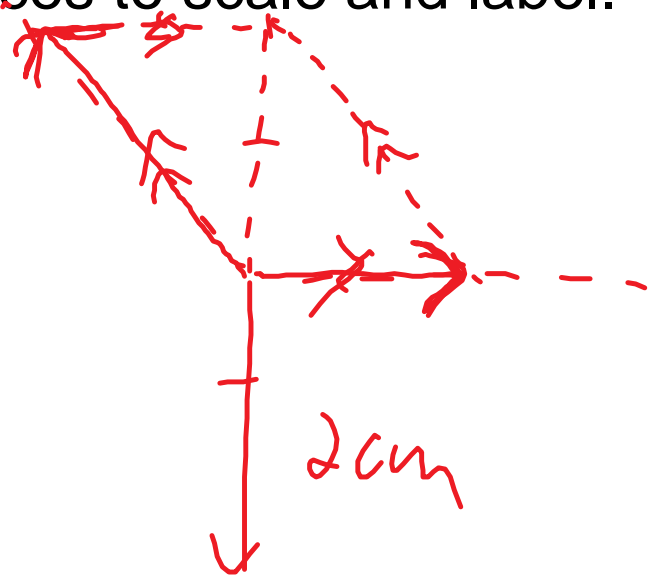
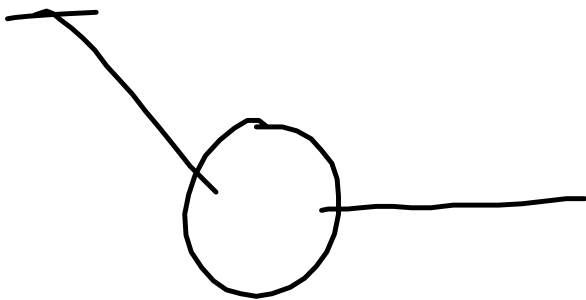
The restoring force is NOT an action-reaction pair with gravity. It reacts to the force you push on the surface.

What is the action reaction pair of gravity pulling on you?





Worksheet: Free body diagrams to scale. Get a ruler, measure 2.0 cm on the diagrams for gravity. Make other forces to scale and label.



Q20 on →

Circular motion - acceleration towards the centre of the circle

P92 Q1-17 odds

Quiz Wednesday Simple harmonic motion, vectors and projectiles

Test October 24th